

Chapter 11

Conclusion

Although the annual number of aviation accidents has decreased slowly in the years from 1989 to 1995, the proportion of accidents in which weather is cited as a causative or contributing factor has remained in the 20-23 percent range. This fact is a serious concern for the aviation community. The annual estimated weather-related cost of over \$3 billion in accidents, delays, diversions, and unexpected operating costs is staggering.

In an effort to bring both the number and costs of weather-related accidents down, this document — *National Aviation Weather Initiatives* — has drawn on the results of FAA User Forums, previous documents by other aviation groups, and its own immediate predecessor, the *National Aviation Weather Program Strategic Plan*, to formulate a set of five objectives:

- provide improved aviation weather information,
- enhance the ability of decision makers to use the information,
- improve the capabilities for aircraft to fly safely and efficiently in all types of weather conditions,
- facilitate improvements by forging the required institutional arrangements, and
- direct and utilize research related to aviation weather.

A total of 86 initiatives for achieving these objectives are described in this document. They were developed in the examination of eight specific aviation weather Service Areas. The body of initiatives can form the nucleus of operating plans for some agencies and implementation plans for others. In all cases the initiatives can form the basis for agency-specific and cross-agency budgetary requests.

1. *Emerging Themes in the Initiatives*

Implementation of any of the identified initiatives will lead to savings of lives, property, and operating costs in the specific Services Areas examined. If the whole body of initiatives is examined in terms of its potential for impact across more than one Service Area, several additional facts relating to their implementation become quite clear:

- very few of the initiatives stand alone, applying only to one particular Service Area, and
- because so many initiatives will have significant impact on a broad scale, they open up opportunities for resource leveraging and inter-agency cooperation.

Restating these broad-scope initiatives in terms of the fundamental service improvements sought, rather than in terms of specific Service Areas, leads to several overarching themes for significantly improving aviation weather services:

- Implement Flight Information Service capabilities.
- Develop and implement multifunctional color cockpit displays that incorporate Flight Information Services products.
- Expand and institutionalize the generation, dissemination, and use of automated PIREPs, including expanding the range of parameters observed, to different segments of the aviation community, such as general aviation and air taxis.
- Improve the underlying weather forecasting science across all Service Areas.
- Require, develop, and implement training packages for ATC service providers, pilots, and other users.
- Improve aviation weather telecommunications capabilities for ground-to-ground dissemination of aviation weather products, including bulk weather data distribution.
- Establish standards, for both national and international use, for objectively characterizing various weather phenomena.

No one of these themes will significantly reduce weather-related accidents by itself. Taken together, however, they point directly to the various aspects of the overall problem: *provide the best possible weather observations and forecasts to knowledgeable, trained decision makers in a timely fashion to meet their operational needs*. The relations between these themes, which represent a majority of the identified initiatives, and the overall objectives of this Initiatives document are demonstrated in Table 2.

The purpose in identifying these themes is not to replace the recommended initiatives with a short list of actions to be taken. Rather, these themes serve as focal points around which agency plans and operations can be centered in the drive to reduce weather-related accidents and improve operating efficiencies in the National Airspace System.

1.1 Flight Information Services. Sound weather decisions concerning aviation safety and efficiency require as complete a view of current and forecast conditions as possible. This complete view of conditions has several facets. One of the most important is that it has to be delivered directly to decision makers. Flight Information Service capabilities currently under development will provide rapid and automated communications links between providers and decision makers at the various ATC service provider stations, the airline operations center dispatch desks, and the cockpits of aircraft en route. Observational summaries of current weather and forecast products can be disseminated by providers within minutes of their development using for example data link capabilities. Systems at the receiving ends of the communication links can translate the information into suitable products that are consistent in their information content but formatted to meet the needs of the specific users.

	<i>Provide Improved Weather Information</i>	<i>Enhance Decision-Maker Capabilities</i>	<i>Improve Aircraft Capabilities</i>	<i>Forge Institutional Arrangements</i>	<i>Direct and Utilize Research</i>
Flight Information Service	X			X	X
Cockpit Displays		X	X	X	X
Automated PIREPs	X		X	X	X
Improved Forecasting	X	X		X	X
Training		X		X	X
Current Communications	X	X		X	X
Objective Standards		X		X	X

Table 2. Relationships between the Emerging Themes and the stated objectives.

1.2 *Cockpit Displays.* In nearly every Service Area discussion the need for a graphical color cockpit display of weather data stood out. Pilots would have the option of calling up phenomena-specific graphic displays separately or overlaying depictions of multiple phenomena and/or terrain features and other traffic in their path. Such display capability, when combined with data link to provide rapid updates and with expanded and improved observation and forecast products, would lead to practically “real-time” weather information in the cockpit.

1.3. *Automated PIREPs.* Meteorological sensors placed on aircraft themselves can provide the most current and relevant weather observations, since data can be taken “where the planes are.” Data from aircraft flying established routes are invaluable for enroute weather observations and forecasts in the National Airspace System. Systems that automatically record weather data and report them back to central receiving locations are becoming more common, especially in more sophisticated aircraft. Efforts are needed to reduce the cost of such systems so that they can be installed in a wider variety of aircraft types and categories. These data must also reach the National Weather Service infrastructure for inclusion in analyses and forecasts. Timeliness is essential because such data are highly perishable.

1.4 *Improved Forecasting.* A complete view of present conditions in the atmosphere is critical for NAS operation; equally critical is the ability to project changes in weather conditions into the near future, whether that be the next hour or the next six hours. Current National Weather Service systems produce high-quality forecast products that are as accurate as possible within the limitations of data resolution in both space and time and within the limits of present understanding of the phenomena being forecast. The steadily increasing availability of data from aircraft-based and satellite-based sensors, coming on-line at higher data rates and resolutions, provides exciting

opportunities not only for advancing the understanding of complex meteorological phenomena but also for using that widened understanding, coupled with an expanded view of atmospheric conditions, to produce forecasts and forecast products with ever higher value for decision makers. Tools for quality control and assimilation of data need to be refined as input grows. Improved understanding of how what is measured relates to the physical processes driving atmospheric changes needs to be translated into more effective forecast models. Emphasis needs to be placed on the time and space scales critical to safe and efficient aviation. Equally important is the aviation weather forecaster, who must be provided with the best possible guidance products as well as the knowledge and means for forecast verification so that a value-added service is provided to the forecast process.

1.5 Training. Another strong theme throughout the service area discussions is the need for both initial and recurrent training of pilots (air carrier, business, military, and general aviation), ATC service providers, aviation weather forecasters, and airline dispatchers to keep them aware of the impact of weather on their decisions. Such training must provide a clear understanding of the various hazardous phenomena, the conditions under which they are most likely to occur, the impact these phenomena can have on a single aircraft, the impact they can have on a wide area of airspace, techniques for avoiding hazardous situations in the first place, and tools for extricating an aircraft from such encounters. The training should also address evolving weather information products and systems to help decision makers know how to make best use of new systems and how to derive the greatest understanding from the exciting new ways weather information continues to be displayed. In this regard, interagency coordination must be directed toward the development of a comprehensive training program that improves the practical meteorological skills of users and providers of aviation weather services.

1.6 Current Communications. Evolving systems such as data link hold promise of providing rapid communication of observation and forecast products. However, the already considerable current aviation telecommunications infrastructure must also be improved to enhance its ability to handle ground-to-ground dissemination of weather products, not only forecast products but data sets as well. Both providers and decision makers must examine the information needs within the aviation community to determine what types and volumes of information are needed where and when. That analysis must lead to the development of communications paths and frequencies that will facilitate rapid dissemination into the hands of decision makers.

1.7 Objective Standards. Communications between providers and decision makers, between pilots and ATC personnel, between dispatchers and pilots, are more effective if objective standards for describing conditions are adopted. To be most effective, such standards should be keyed to measurements by sensing systems rather than to pilot observations. They should be clear for all types of aircraft as well. However they are defined, they must be unambiguous. Once established, they must also be integrated into weather information products and training curricula to maintain consistency in usage and understanding.

2. *Perspectives for Future Steps*

Reducing the number of weather-related fatal aircraft accidents and delays involves more than establishing strategic goals and developing initiatives. The words which have been put to paper in the *Strategic Plan* and in this document must be translated into action; where current programs exist to support initiatives, resources should continue to be provided; where programs do not exist, new efforts should be initiated.

The next step will involve the formation of government-industry teams chartered to undertake solution-based service designs. These teams, which will have membership from the cooperating organizations identified in the initiatives, will evaluate the current status of the initiatives and then make recommendations as to activities that need to be initiated to bring an initiative to reality. In order to ensure interagency coordination and maximum use of resource leveraging opportunities, the National Aviation Weather Program Council within the Office of the Federal Coordinator will provide oversight and guidance.

The groundwork has been done; the *Strategic Plan* provided the vision of a safer and more efficient National Airspace System; the *National Aviation Weather Initiatives* have focused on specific areas where modest investments can reap significant benefits. It now falls to the agencies and the aviation industry to continue with the solution-based approach which will lead to continued support of existing programs and justification for new programs to satisfy the initiatives identified in this document.